(19) Europäisch s Patentamt
European Patent Offic
Office européen des brev ts

(11) Publication number: **0 467 143 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91110931.2**

(51) Int. Cl.5: **G11B 15/67**

(22) Date of filing: **02.07.91**

(30) Priority: **18.07.90 JP 191017/90**

(43) Date of publication of application:
22.01.92 Bulletin 92/04

(84) Designated Contracting States:
DE FR GB

(71) Applicant: **FUJITSU LIMITED**
1015, Kamikodanaka Nakahara-ku
Kawasaki-shi Kanagawa 211(JP)

(72) Inventor: **Ohshita, Masaru, c/o Fujitsu Limited**
Pat. Dep.
1015 Kamikodanaka, Nakahara-ku
Kawasaki-shi, Kanagawa 211(JP)

(74) Representative: **Stebbing, Timothy Charles et al**
Haseltine Lake & Co. Hazlitt House 28
Southampton Buildings Chancery Lane
London WC2A 1AT(GB)

(54) A tape threading apparatus used in a tape unit.

(57) A tape threading mechanism used in a magnetic tape unit which deals with a cartridge-contained magnetic tape with a leader block (3) attached at an end of the magnetic tape. The mechanism is provided for pulling out the leader block from the cartridge (1), performing a tape threading/unthreading operation, and inserting the leader block back into the cartridge. The mechanism includes a threading arm, connected to a rotational axis at one end and at the other end provided with a pin (8) for carrying the leader block, which consists of a linkage of two arms (17, 18), at least one of the arms having an elastic member (19) which allows the threading arm to expand and contract lengthwise. The elastic member facilitates proper insertion of the leader block in the cartridge with only a small applied force.

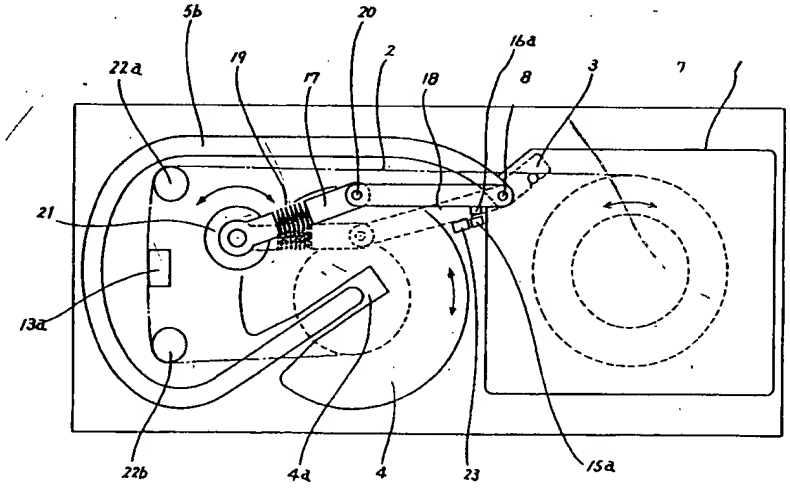

FIG. 3

EP 0 467 143 A2

The present invention relates to a tape unit which takes a tape cartridge (e.g. a cartridge having a single reel of magnetic tape, hereinafter simply called a cartridge) used, for example, in a file store of a computer system, or more particularly to an apparatus for threading (including unthreading) tape of a cartridge in a tape unit.

When a write or read operation is to be performed on a magnetic tape of a cartridge, the cartridge is first loaded into a magnetic tape unit, then the magnetic tape is threaded through the threading path and wound on a machine reel of the magnetic tape unit to establish a running path of the magnetic tape.

With the ever-increasing demand for small-sized computer systems, demand for a small-sized magnetic tape unit is also increasing.

It is an absolute necessity for attaining high reliability of magnetic tape unit to correctly carry out threading and unthreading of the magnetic tape.

Therefore, there is a demand for a threading apparatus which allows a small-sized magnetic tape unit to be realized and which carries out tape threading and unthreading securely.

The drawbacks of an existing cartridge will now be explained with reference to Fig. 1. Fig. 1(a) is a perspective view of the cartridge; Fig. 1(b) is a sectional view of the cartridge showing a leader block ready to be inserted therein; and Fig. 1(c) is a sectional view with the leader block inserted.

The cartridge 1 has a reel with magnetic tape 2 wound thereon. The end of the magnetic tape 2 is connected to a leader block 3 used for pulling the magnetic tape 2 out of the cartridge 1. The leader block 3 is usually in the inserted state, in which it is latched in the cartridge 1.

When the leader block 3 is pushed into the cartridge opening in the state shown in Fig. 1(b), the tongue 3a of the leader block 3 rides over the cartridge tongue 1a which is molded in synthetic resin, and becomes latched thereon as shown in Fig. 1(c).

The cartridge tongue 1a is resilient and produces an opposing spring force when the leader block 3 is pushed into or pulled out of the cartridge 1, so a certain force is needed to insert the leader block. For instance, the ANS Standard stipulates that the insertion force F required to push the leader block into its latched position in the cartridge should not exceed 1.23 kg.

Fig. 2 is a schematic diagram showing a previously-proposed magnetic tape threading mechanism. In the Figure, the chain line T shows the path along which a magnetic tape is threaded and M shows a threading motor.

When the cartridge 1 is loaded on a magnetic tape unit, the magnetic tape 2 is pulled out of the reel of the cartridge 1 and led to the machine reel 4 after being threaded through a tape guide 12a, a magnetic head 13, a tape guide 12b and a tension roller 14.

Threading of the magnetic tape 2 is carried out by a panto-arm consisting of the first arm 6, second arm 7, third arm 9 and fourth arm 10. As the panto-arm swings, a pin 8 provided at an end of the panto-arm pulls out the leader block 3 which is provided at the end of the magnetic tape 2, and a guide pin 11 of the panto-arm moves along the guide groove 5a to the machine reel 4 to engage the leader block 3 with the leader block groove 4a of the machine reel 4.

For unthreading the magnetic tape 2, the above sequence is reversed and, when a flag 16 attached to the second arm 7 comes in front of a photosensor 15, the photosensor 15 detects that the leader block 3 is inserted and causes the panto-arm to stop swinging.

Accordingly, the conventional threading mechanism has the following problems:-

(1) In a threading mechanism using a panto-arm, the magnetic tape has to travel over a wide ranging tape path, which makes the magnetic tape unit large in size.

(2) A large insertion force F is required to insert the leader block 3 into the cartridge 1. To get an insertion force F large enough, the panto-arm has to be swung at a high rotational speed at the moment when the leader block 3 is inserted into the cartridge 1. The leader block insertion may fail however, in which case the panto-arm rebounds due to a spring return force acting on the leader block 3.

(3) The leader block insertion may fail due to a dimensional error of cartridge 1 or positioning error of the cartridge 1 loaded into the magnetic tape unit.

(4) Even when the leader block insertion fails, the above-mentioned photosensor 15 may falsely detect the flag 16 and cannot judge correctly whether or not the leader block 3 is really inserted in the cartridge 1. As a result, the magnetic tape unit is caused to malfunction and the computer system to be halted.

The following are representative of the prior art in the area of threading apparatus:- Japanese Laid Open Patents, Provisional Publication Nos. 62-257657, 62-119765, 60-10446 and 63-10360.

According to the present invention, there is provided a tape threading apparatus used in a tape unit for performing a threading operation to pull out from a cartridge a leader block attached at an end of a tape, thread and unthread the tape and insert the leader block back into the cartridge, said tape threading apparatus comprising:-

a threading arm for threading the magnetic

tape, connected at one end to a rotational axis and at the other end provided with engaging means for engaging the leader block, and consisting of a linkage of a plurality of arms, at least one of the arms having an elastic member which allows said threading arm to expand and contract lengthwise.

An embodiment of the present invention may provide a mechanism for securely locking the threading arm where the leader block is to be latched in the cartridge.

An embodiment of the present invention may provide a mechanism for judging correctly whether or not the leader block is properly inserted in the cartridge.

An embodiment of the present invention may provide a small-sized threading mechanism.

An embodiment of the present invention may also provide a small-sized and highly reliable tape unit for information-storing tape such as magnetic tape.

Reference is made, by way of example, to the accompanying drawings in which:-

Fig. 1 is a diagram illustrating an outline of a cartridge;

Fig. 2 is a schematic diagram showing a magnetic tape threading mechanism;

Fig. 3 is a schematic diagram showing a magnetic tape threading mechanism of the first embodiment of the present invention;

Fig. 4 indicates the forces acting on a linkage;

Fig. 5 shows a threading operation performed by the first embodiment of the present invention;

Fig. 6 is a schematic diagram showing a magnetic tape threading mechanism of the second embodiment of the present invention;

Fig. 7 shows a detailed construction of the threading arm of the second embodiment of the present invention; and

Fig. 8 shows a threading operation performed by the second embodiment of the present invention.

Throughout the drawings, identical reference numerals are used to designate the same or similar components.

Referring to Fig. 3, in a first embodiment of the invention, a linkage consisting of two arms 17 and 18 pulls the leader block 3 out of the cartridge 1 and threads the magnetic tape. The arm 17 is connected to a threading motor 21 which swings the linkage and the arm 18 is provided with a pin 8 for pulling out the leader block 3.

At least one of the arms 17 and 18 is provided with an elastic member 19 which expands and contracts lengthwise along the threading arm consisting of the arms 17 and 18. The total length of arms 17 and 18 is set longer than the distance between the rotational axis of the threading arm and the leader-block pick-up position where the leader block 3 is latched in the cartridge 1.

A guide groove 5b for guiding the pin 8 is provided along the threading path between the leader-block pick-up position and the leader block engaging groove 4a of machine reel 4.

How the threading mechanism performs leader-block insertion is explained below.

The threading arm consisting of arms 17 and 18 swings and carries the leader block 3 into the cartridge opening. The arms 17 and 18, which are doglegged at this point, straighten by compressing the elastic member 19, become reversely doglegged again and finally stop at the position where the arm 18 strikes against a stopper 23.

A sensor 15a for detecting the threading arm is provided slightly before the position where the arm 18 comes into contact with the stopper 23. The sensor 15a causes the threading motor 21 to stop on detecting the arm 18.

How the threading mechanism threads and unthreads the magnetic tape 2 will now be explained with reference to Fig. 3.

When threading the magnetic tape 2, the threading motor 21 rotates counterclockwise to make the arm 17 pull the arm 18 by means of node (joint) 20. The pin 8 provided at the end of the arm 18 pulls the leader block 3 out of the cartridge 1, travels along the guide groove 5b while pulling the leader block 3 and engages the leader block 3 with the leader block engaging groove 4a of the machine reel 4.

When unthreading the magnetic tape 2, the threading motor 21 rotates clockwise. The pin 8 travels back along the guide groove 5b while pulling the leader block 3 to insert the leader block 3 into the cartridge 1. During insertion, the leader block 3 has to be pushed against the opposing force of the tongue provided in the cartridge 1, causing a shock to both cartridge 1 and the threading arm.

The elastic member 19 provided on at least one of the arms 17 and 18, provided in the present invention, can expand and contract lengthwise along the threading arm, thereby absorbing the shock and preventing the threading arm from rebounding.

Two aspects of the insertion process are explained in more detail as follows.

(1) Leader-block Insertion Force by the Threading Arm

The threading mechanism of the present invention can absorb the shock which hinders the leader block 3 from being inserted into the cartridge 1 and, thus, can effectively insert the leader block 3 with only a small torque.

Fig. 4 illustrates the forces acting on a linkage. When a linkage consisting of arms 24 and 25, which are rotatably coupled at each end by

a node 20a, is dogl gged and placed on th floor with the oth r end of the arm 24 pressed against a wall, a vertical force Fi applied on the node 20a causes a horizontal force Fo to act on the other end of th arm 25. Th force Fo is expressed as:-

$$Fo = Fi \sin \theta/2 \cos \theta$$

where it is assumed that the arms are equal in length and neglecting frictional force exerted on the other end of the arm 25 by the floor surface.

Therefore, the closer the angle θ is to $\pi/2$ (radian), the larger the force Fo which can be obtained with a given force Fi. The force Fo corresponds to the leader-block insertion force generated by the linkage in the present embodiment.

(2) Self-lock Function

The threading mechanism can also be given a self-lock function by means of the stopper 23 and, thus, insert the leader block 3 securely.

Fig. 5 shows the threading operation performed by the first embodiment of the present invention. Figs. 5(a) to (c) illustrate sequential stag s in this operation, particularly leader-block insertion, as follows:-

(a) Leader-block Insertion Starting Stage

The threading motor 21 rotates clockwise to make the pin 8 carry the leader block to the cartridge opening. The arms 17 and 18 are doglegged at this point, since the total length of the arms is set longer than the distance between the leader-block pick-up position and the rotational axis of the arm 17.

(b) Leader-block Inserting Stage

The threading motor 21 rotates clockwise further and the doglegged arms 17 and 18 straighten while compressing the elastic member 19.

The threading arm consisting of arms 17 and 18 pushes the leader block 3 into the cartridge 1 with a force Fp equal to the force compressing the elastic member 19. That is, the leader-block insertion force depends on the elasticity of the elastic member 19. Therefore, the elastic member 19 should be designed so that the force Fp provides a desired leader-block insertion force. The torque given to the arm by the motor 21 can be small in comparison with the force Fp and, therefore, a small-sized motor having a low torque can be used as the threading motor.

(c) Arm Self-locking Stage

As the threading motor 21 rotates clockwise still further, the arms 17 and 18 become reversely doglegged after passing through the straightened state of Fig. 5(b), and stop swinging when arm 18 strikes the stopper 23.

Wh n the arms 17 and 18 become slightly doglegged immediately after passing the above-mentioned straight ned state, the arms 17 and 18 and threading motor 21 receive a clockwise torque due to the spring force of the elastic member 19.

Thus, a force Fs which presses the arm 18 against the stopper 23 can be obtained without supplying a torque from the threading motor 21 and, therefore, the threading mechanism can maintain a stable self-locking state.

Therefore, by providing a sensor 15a at a position slightly before the position where the threading arm contacts the stopper 23, and by stopping the motor 21 in response to this sensor, the threading mechanism can be held in position even if motor 21 is switched off.

When the threading mechanism enters the self-locking state after the threading motor 21 stops, the leader block 3 is pushed into the cartridge 1 by the force Fp of the elastic member 19.

Accordingly, when the sensor 15a continues to detect the threading arm, it can be judged that the leader block 3 has been correctly inserted into the cartridge 1.

For example, the sensor 15a shown in Fig. 5 detects the presence of the threading arm by detecting a flag 16a provided on the arm 18.

Fig. 6 illustrates a second embodiment of the present invention.

The threading mechanism of this embodiment includes first and second arms 17a and 18a, and an elastic member consisting of springs 19a provided on the first arm 17a.

A driving gear 26 is provided on the rotational axis of the first arm 17a, and a driven gear 27, which engages the driving gear 26, is provided on a threading motor 21a. The rotational speed of the motor is reduced via the driving gear 26 and driven gear 27, to generate a large force for swinging the threading arm.

At an end of the second arm 18a are provided a pin 8 for pulling out a leader block 3 and a bearing 34 which is arranged coaxially to the pin 8 (see Fig. 7). The bearing 34 rotates with the pin 8 as a rotational axis to facilitate smooth movement of the pin 8 along a guide groove 5b, formed as a slot in a guide plate 32.

A stopper 23a (Fig. 6) for stopping the threading arm is provided at a position where the second arm 18a is required to stop. The second arm 18a has a flag 16b at its end which is used by a photosensor 15b to detect its presence. The sensor 15b is located slightly before the position where the second arm 18a strikes the stopper 23a.

Fig. 7 shows a detailed construction of the threading arm in this embodiment. Fig. 7(a) is a

p rspectiv view of the first arm, and Fig. 7(b) is a side levational vi w of the threading arm and drive mechanism, a frame 29 being shown in section.

Two slide shafts 32 are inserted through springs 19a and frame 29, with the first arm 17a and an end plate 30 attached at opposite ends. Th frame 29 includes a linear bearing in contact with slide shafts 32, which allows the slide shafts 32 to slide smoothly through the frame 29.

Thus, the first arm 17a moves only in the axial direction of the slide shafts 32 while compressing the springs 19a and, therefore, cannot extend beyond the position where the end plate 30 contacts th frame 29.

Fig. 7(b) shows a state where the springs 19a are compressed and the end plate 30 is apart from the frame 29.

The other end of the first arm 17a is rotatably coupled to an end of the second arm 18a through the node 20b. Thus, the first arm 17a can make a rotational movement as well as a lengthwise movement along its axis. At the other end of second arm 18a, the pin 8 for pulling the leader block 3 is provided. A bearing 34 is provided coaxially to the pin 8 to allow the pin 8 to move smoothly along the guide groove 5b.

The above-mentioned driven gear 26, which reduces the rotational speed of the threading motor 21a in conjunction with the driving gear 27, is attached to the frame 29.

Fig. 8 shows the threading operation in this embodiment. That is, Figs. 8(a), 8(b) and 8(c) illustrate sequential stages in the operation to insert the leader block 3 into the cartridge 1 after it is led to the cartridge opening by the pin 8, along the guide groove 5b provided in guide plate 32.

(a) Leader-block Insertion Starting Stage

The first arm 17a swings clockwise to make the pin 8 carry the leader block to the cartridge opening. The first arm 17a and second arm 18a are doglegged at this point, since the total length of the arms is set longer than the distance between the leader-block pick-up position and the rotational axis of the first arm 17a.

(b) Leader-block Inserting Stage

The first arm 17a swings further clockwise, and the doglegged arms 17a and 18a straighten as the springs 19a are compressed. The slide shafts 32 are pressed toward the frame 29 and the end plate 30 moves away from the frame 29.

The threading arm consisting of the first arm 17a and second arm 18a pushes the leader block 3 into the cartridge 1 with a force Fp equal to the force compressing the spring 19a.

The compression force Fp of the spring 19a is set to a value, e.g. 2.5 kg force, sufficient to ensure that the leader block 3 is inserted into the cartridge.

(c) Arm Self-locking Stage

As th first arm 17a swings clockwis still further, the arms 17a and 18a become reversely doglegged after passing th straightened state, and stop swinging when the stopper 23a is struck.

At this stage, the force Fs which presses the arm 18a against the stopper 23a can be obtained without applying torque from the threading motor 21, so the threading mechanism can maintain a stable self-locking state.

The threading motor is stopped when the sensor 15b detects the flag 16b. Thus, if the sensor 15b continues to detect the flag 16b with the threading mechanism in a stable self-locking state, it can be judged that the leader block 3 has been successfully inserted into the cartridge 1.

As described above, a threading arm consisting of a linkage of two arms, one of which includes an elastic member, can absorb a shock caused when inserting a leader-block, can insert the leader block with a small torque and can also maintain itself in a stable self-locked state at the leader-block pick-up position. A sensor can confirm leader-block insertion by detecting the threading arm in the self-locked state. Accordingly, leader-block insertion can be accomplished surely and economically by a tape threading mechanism of a simple configuration.

Claims

1. A tape threading apparatus used in a tape unit for performing a threading operation to pull out from a cartridge a leader block attached at an end of a tape, thread and unthread the tape and insert the leader block back into the cartridge, said tape threading apparatus comprising:-

   a threading arm for threading the tape, connected at one end to a rotational axis and at the other end provided with engaging means for engaging the leader block, and consisting of a linkage of a plurality of arms, at least one of the arms having an elastic member which allows said threading arm to expand and contract lengthwise.

2. A tape threading apparatus according to claim 1, wherein the effective length of said threading arm is set longer than the distance between the rotational axis of said threading arm and the position where the leader block is inserted into the cartridge.

3. A tape threading apparatus according to claim 1 or 2, wherein said engaging means is a pin

on which the l ader block is carried.

4. A tap threading apparatus according to claim 3, further comprising guidance means for guiding the pin so that th pin carries the leader block along the tape running path.

5. A tape threading apparatus according to any preceding claim, further comprising a stopper for stopping said threading arm from swinging wh n the leader block is being inserted into the cartridge, the stopper being provided at a position where said threading arm becomes doglegged again after having become doglegged with the leader block striking the cartridge and then having become straight with the elastic member compressed.

6. A tape threading apparatus according to claim 5, further comprising a sensor for detecting said threading arm to judge that the leader block has been inserted into the cartridge, provided before the position where said threading arm comes into contact with said stopper.

7. A tape threading apparatus according to claim 6, wherein said sensor, on detecting said threading arm, causes a motor for swinging said threading arm to stop.

8. A tape threading apparatus according to any preceding claim, wherein said threading arm comprises a linkage of a first arm and a second arm rotatably coupled together and includes a shaft, inserted through a spring and a frame, having said first arm and an end plate attached at opposite ends.

9. A tape threading apparatus according to claim 8, wherein said frame includes a bearing in contact with said shaft for allowing said shaft to slide through said frame.

10. A tape threading apparatus according to claim 4, wherein a bearing is provided coaxially to the pin to facilitate movement of the pin along said guidance means.

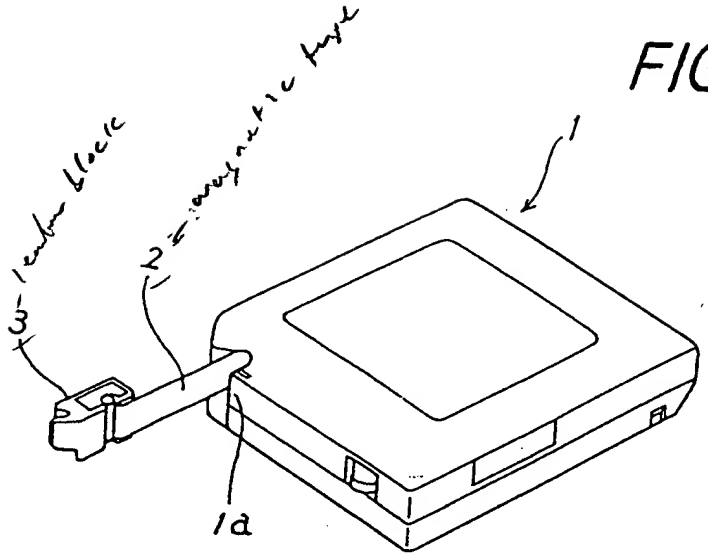

FIG. 1 (a)

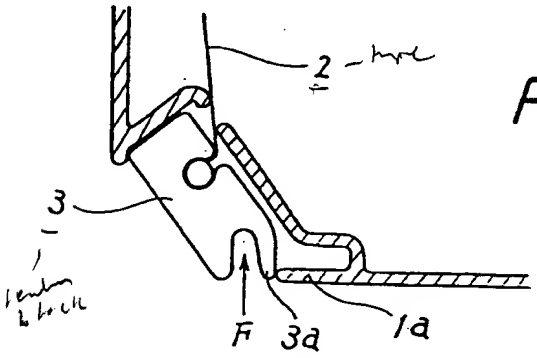

FIG. 1 (b)

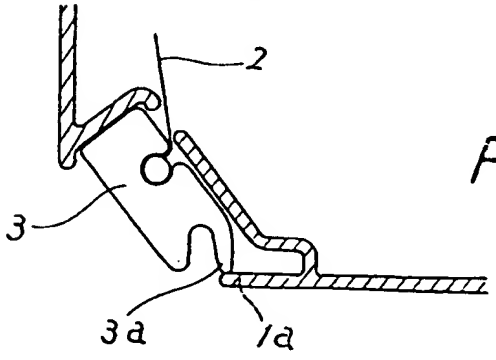

FIG. 1 (c)

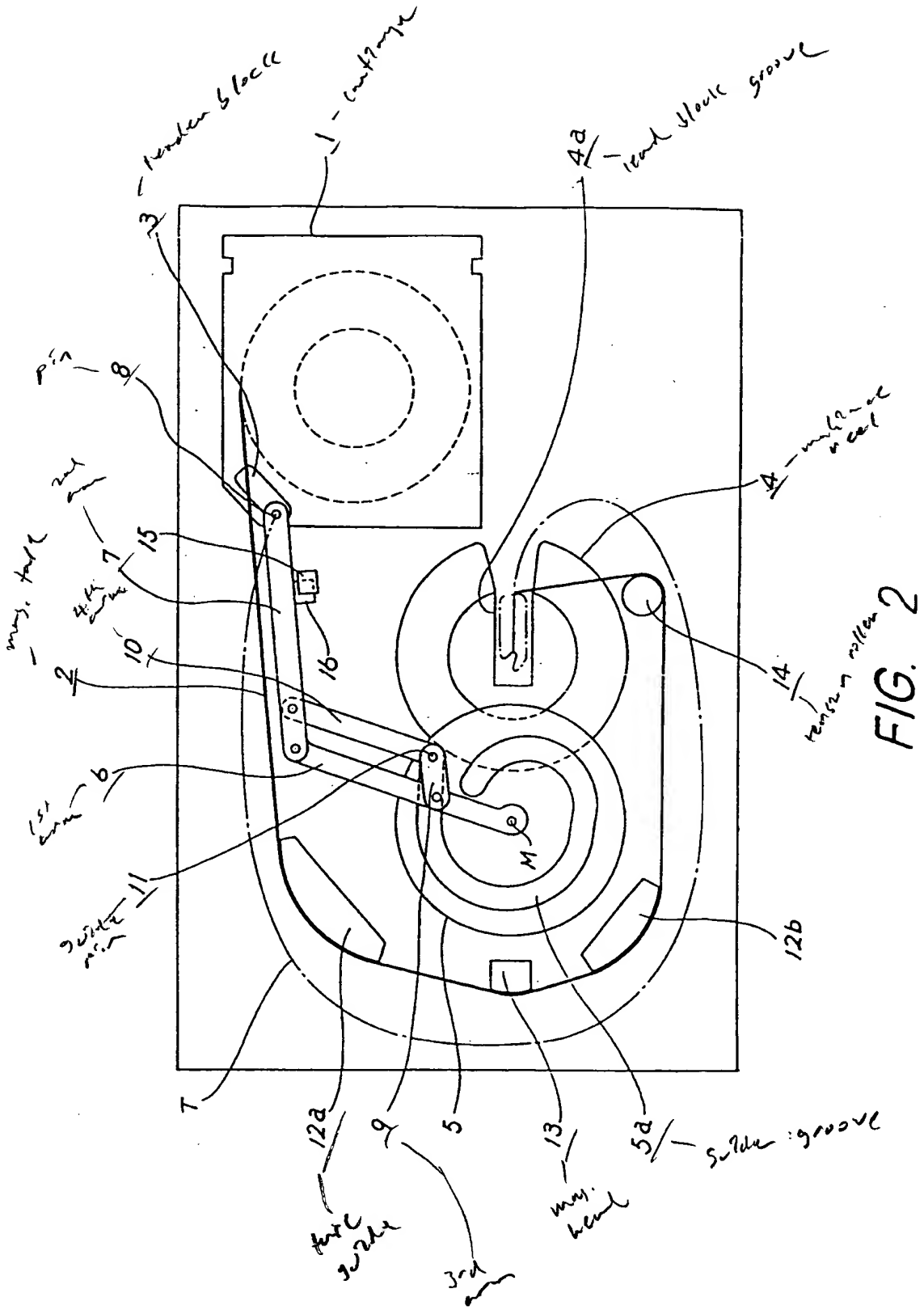

FIG. 2

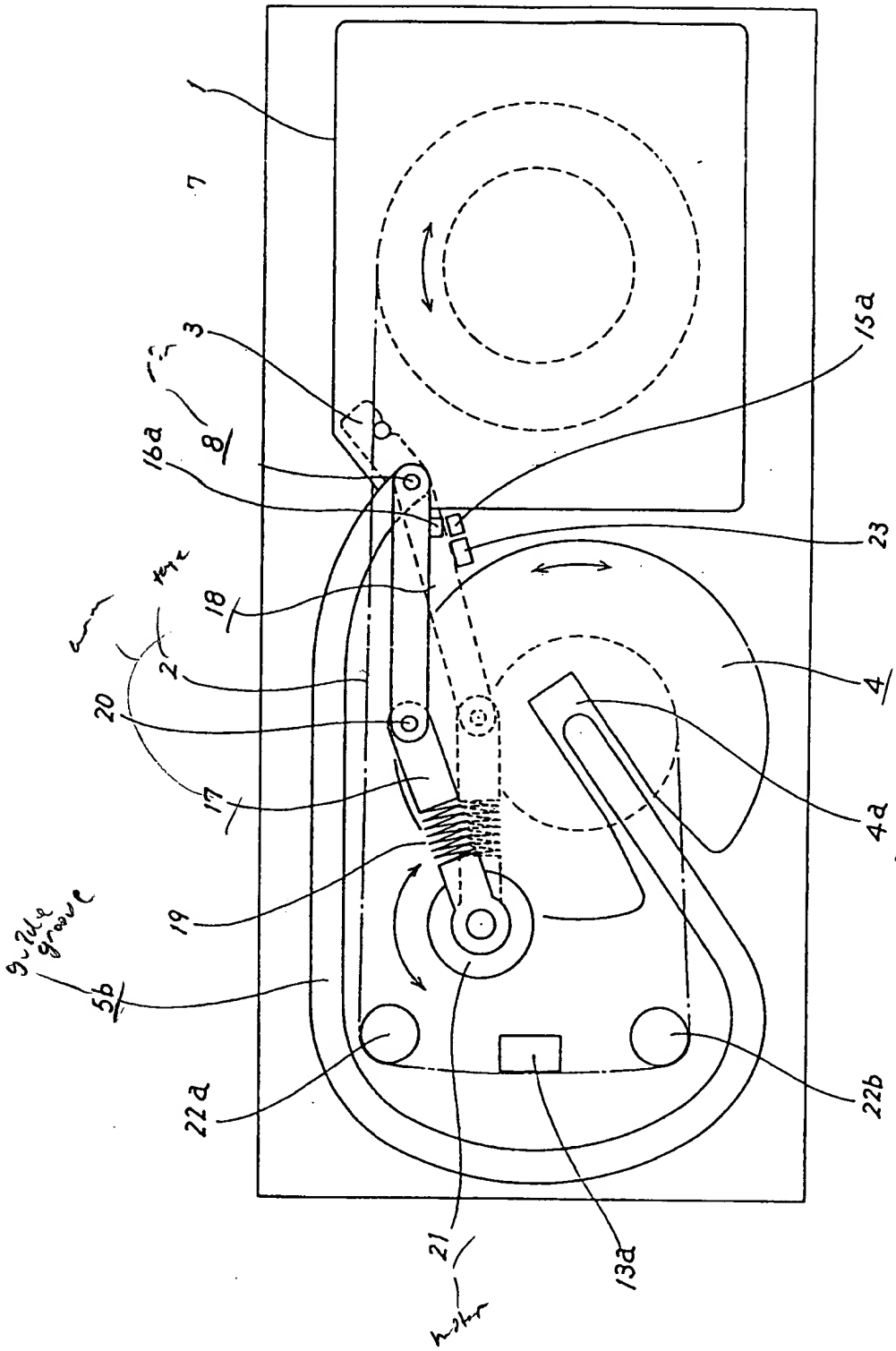

FIG. 3

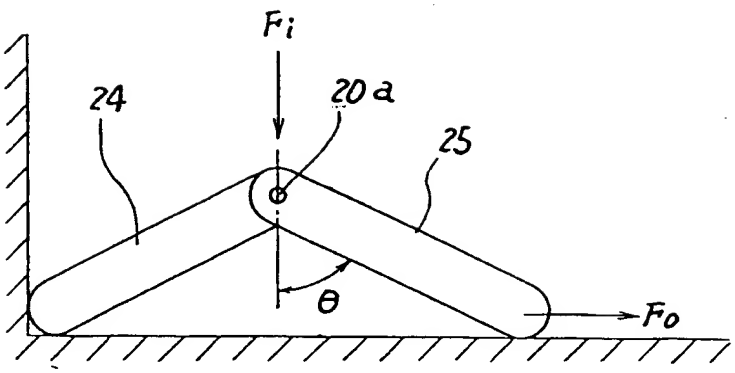

FIG. 4

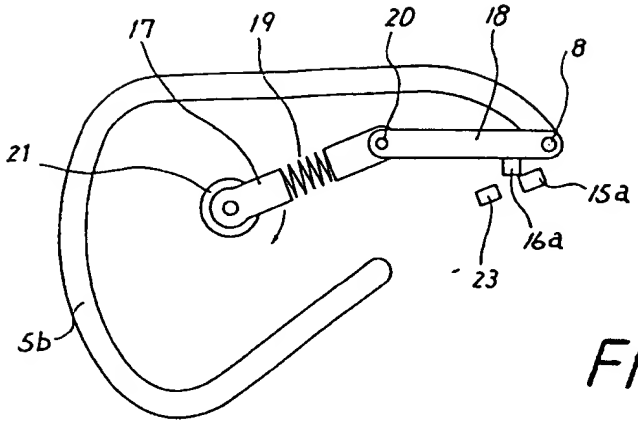

FIG. 5 (a)

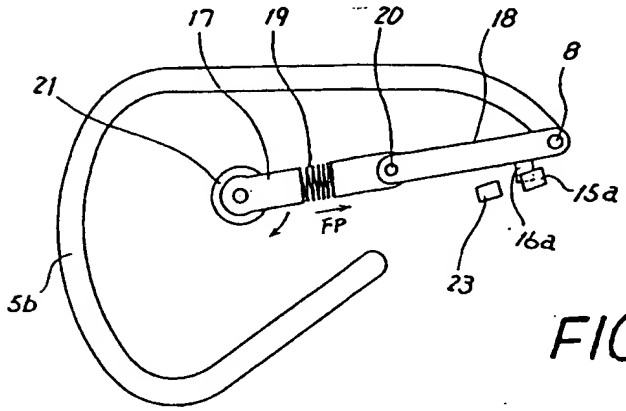

FIG. 5 (b)

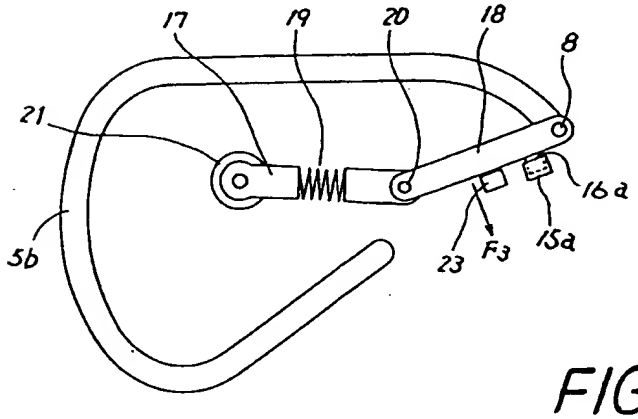

FIG. 5 (c)

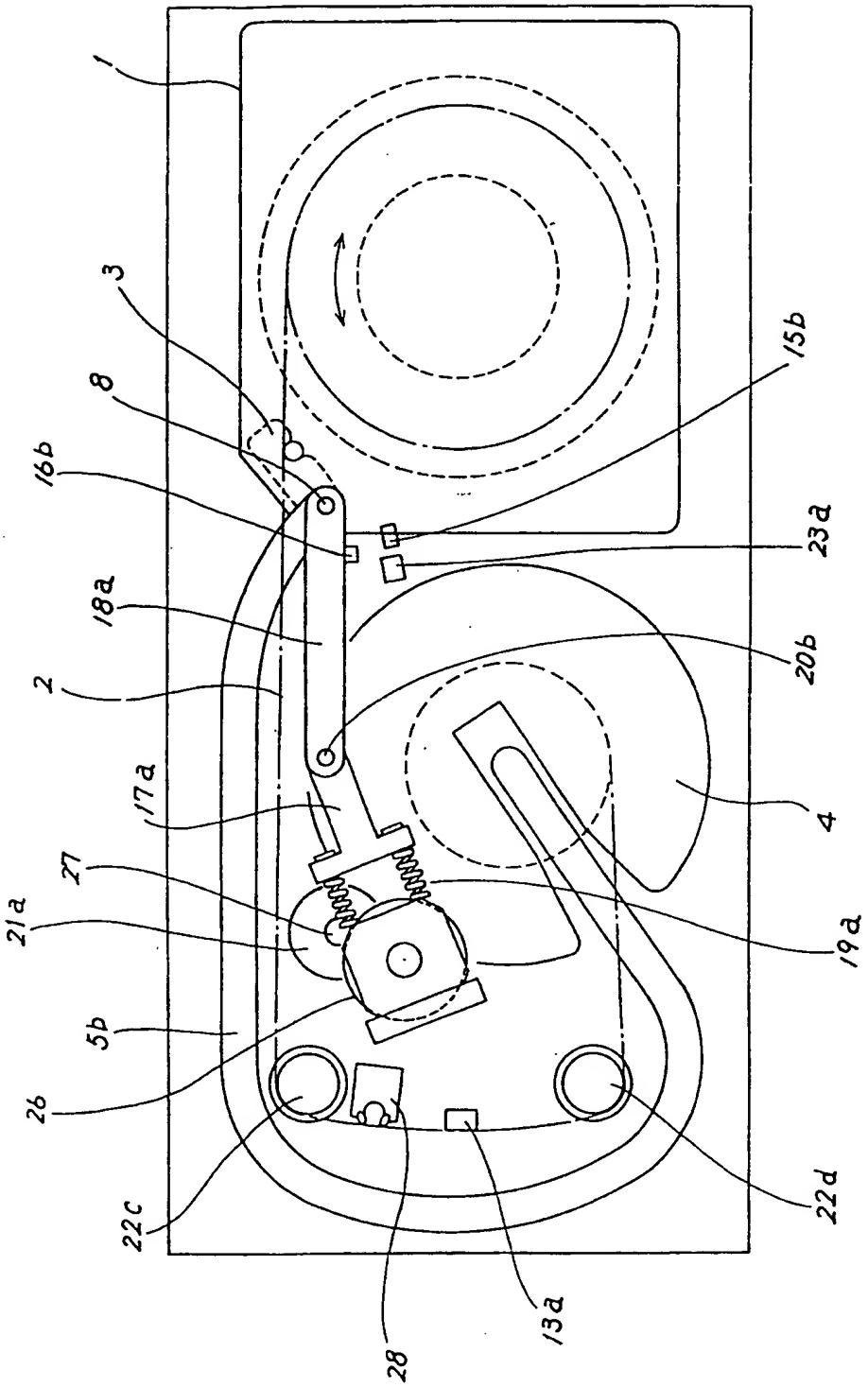

FIG. 6

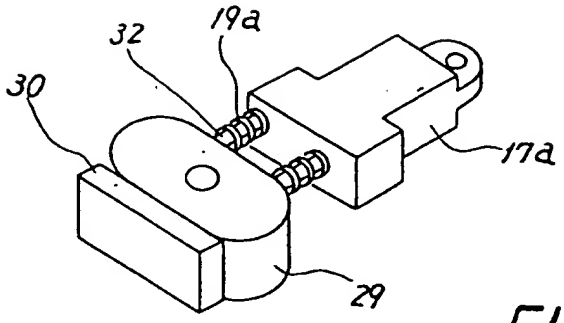

FIG. 7 (a)

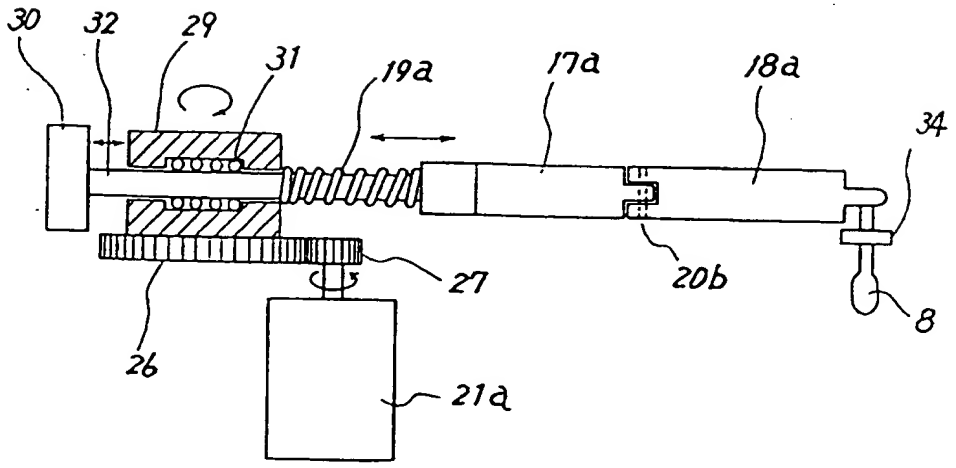

FIG. 7 (b)

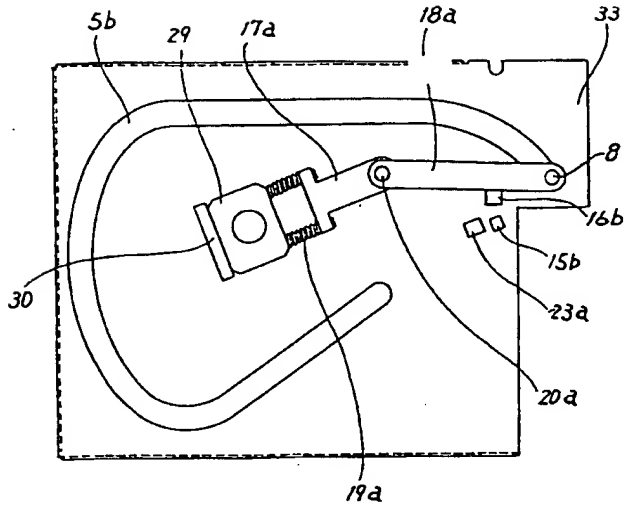

FIG. 8 (a)

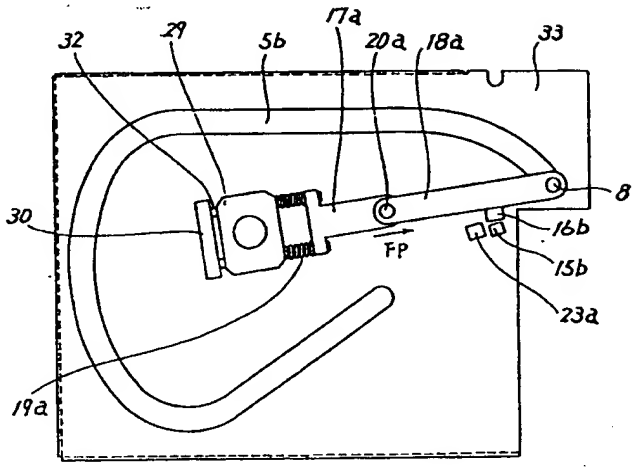

FIG. 8 (b)

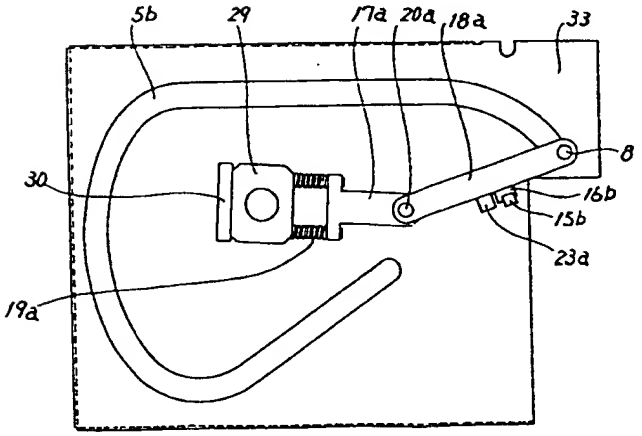

FIG. 8 (c)